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STRATEGIES FOR AN INTEGRATED DEVELOPMENT OF AGRICULTURE WITH LOCAL PRODUCTION OF IRRIGATION HARDWARE AND OTHER AGRICULTURAL EQUIPMENT BY SMALL- AND MEDIUM-SCALE MANUFACTURERS*

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TABLE OF CONTENTS

	Paragraphs	Page
BACKGROUND	1 - 4	3
INTRODUCTION	5 - 9	4
I. MANUFACTURING POLICIES AND STRATEGIES	10 - 18	5
II. THE IMPORTANCE OF DOMESTIC PRODUCTION AND POSSIBLE APPROACHES FOR ITS EXPANSION	19 - 31	7
III. POINTS FOR DISCUSSION	32 - 36	10
ANNEX 1		13
ANNEX 2		14

BACKGROUND

1. Agricultural mechanization is playing a role of growing importance in increasing food production in most developing countries. World population is increasing at a faster rate than is food production. It is estimated that by the year 2000 the world population will further increase by approximately 2 billion, thus reaching between 6 and 6.5 billion. Approximately 80 per cent of that population growth will take place in developing countries. Furthermore, the continuous migration from rural areas to urban centres will result in increasing scarcity of labour for agriculture. All developing countries, therefore, have given high priority to the satisfaction of the basic needs of their population and are concentrating their efforts on achieving food security and national self-sufficiency in food production. It is clear that these goals can only be achieved by a number of policy changes, including an active policy aimed at farm mechanization appropriate to the physical, cultural, economic and technological environment of a country or region.

2. Mechanization is one of the main factors to be considered, together with other elements of agricultural development, in achieving a significant increase in land productivity and ultimately in raising the nutritional levels of the population. The agricultural machinery industry has an important role to play in producing the machinery needed to optimize the use of inputs for and outputs from agricultural production. Therefore, planning a more integrated development between agriculture and the agricultural machinery industry can permit each sector's growth to encourage and reinforce the growth of the other.

3. Irrigation is one of the main pillars of agricultural development. Depending on topographical conditions, pumping is often an essential element in irrigation, land reclamation and drainage. In developing countries where agricultural development is given highest priority, the pump and other irrigation equipment should be considered together with other agricultural machinery and related common-purpose capital goods (see annexes 1 and 2). Pump manufacturing should be examined in the context of the multi-purpose approach to the manufacture of agricultural machinery, which was recognized by the Second Consultation on the Agricultural Machinery Industry as a valuable approach for most developing countries.

4. Depending on local conditions, the demand for various types of irrigation equipment and components will differ from one country to another, which means that the required manufacturing facilities and the degree of manufacturing complexity may also differ.

INTRODUCTION

5. The economies of African countries are based primarily on agriculture, with limited levels of industrialization both in engineering and in the allied metal working sector.

6. Analysis by UNIDO of the manufacturing sector in developing countries has shown that in Africa the share of local producers (the rate of self-sufficiency in manufacturing) is only 5 per cent. This is a serious problem since the manufacturing sector is of major importance in providing essential inputs to satisfy the basic needs of the population related to food production and food security.

7. This situation has been aggravated by many factors including the continuing global recession, which has limited the effectiveness of efforts by African countries to increase agricultural production and has slowed progress towards achieving the economic and agricultural development required to attain self-sufficiency in food production.

8. The capacity of developing countries, particularly in Africa, to formulate and implement appropriate or selective mechanization policies is of crucial importance to the improvement of their agricultural productivity.

9. Constraints arising from the lack of adequate policies and strategies, small market size, limited technological capability, as well as a lack of financing, negotiation skills, training, standardization, etc., hinder the development of local production of agricultural machinery.

I. MANUFACTURING POLICIES AND STRATEGIES

10. Decisions related to the manufacture of agricultural equipment in general and irrigation equipment and components in particular require in-depth investigation and feasibility studies in each case in order to select the optimal product mix. The product mix might be different from country to country, owing to variability of local conditions, e.g. agricultural structure, soil conditions, crops grown, land ownership arrangements, etc. The existing technical infrastructure, economy and agricultural system must be considered in working out a proper strategy for integrated development of the industry.

11. From an industrial perspective, policies and strategies for the manufacture of agricultural equipment and irrigation components should be considered within the context of the capital goods sector as a whole. This requirement is another reason why integrated planning of agriculture and industry in general, and the agricultural machinery subsector in particular, is very important.

12. For countries where the industrial base is relatively limited, the multi-purpose approach should be carefully considered, i.e. the local manufacture of pumps for agricultural and other uses should be accompanied by a wider range of other manufacturing activities than is usually the case in developed countries in order to justify the required investment and to achieve better utilization rates, providing at the same time the other elements of agricultural mechanization.

13. The development of a domestic agricultural machinery industry calls for, first and foremost, a considerable effort on the part of developing countries themselves. Through such an effort they can build up their human resources and an industrial base that enables them to negotiate with the owners of technology and increase their participation in project development.

14. As the various types of agricultural machinery, including irrigation equipment and components, are of different manufacturing complexity, the economies of scale of manufacturing them are also different. Local conditions such as technical infrastructure, possibilities of interlinkages, availability of component inputs, price structures, selected degree of integration, etc., also have an impact on the economy of scale of manufacturing.

15. Therefore, in each particular case, an optimal degree of integration for various irrigation components in each developing country must be selected. Market demand, the level of technical skills, and the possibilities of interlinkages with other industrial sectors have considerable impact on an optimal degree of integration, i.e. on decisions about whether to manufacture components or to purchase them from a domestic or foreign supplier.

16. The importance of agriculture is now acknowledged; it is therefore essential that high priority must be given in most developing countries to strengthening the agricultural base before a large-scale programme of industrialization is launched. This is essential for generating the surplus needed for the growth of industry and other sectors, as well as for raising the low standards of living of large segments of the population, most of whom live in rural areas.

17. But the development of agriculture also requires related investment in transport, power and water resources, as well as in other sectors. In the long run, if agriculture is to progress, industry has to expand to produce the fertilizer, pesticides, machinery and implements, and auxiliary services required by agriculture.

18. Owing to the pivotal role of the agricultural machinery industry as the interface between agriculture and industry, its development is of crucial importance for improving and expanding domestic production of a wide range of agricultural tools, machinery and implements, including: hand tools; animal- and power-driven implements; irrigation pumps and pipes; sprayers; dusters; crop-dryers; handling, processing and storage equipment; and tractors.

II. THE IMPORTANCE OF DOMESTIC PRODUCTION AND POSSIBLE APPROACHES FOR ITS EXPANSION

19. Several developing countries are still paying dearly and in foreign currency for irrigation pumping equipment. The scarcity of foreign currency in many developing countries creates such a distorted price structure that the purchase price of pumps for the farmers in those countries is often several times the price in the supplier's country.

20. The high cost of importing and maintaining pumping systems may cause feasible agricultural undertakings to be deferred. Sometimes the lack of spare parts renders imported equipment useless. Pumping equipment tends to wear out and break down rather often, particularly the small units operated by individual farmers. Additionally, pumps often require imported sources of energy. For these reasons, where there is a choice to be made between gravity irrigation and pumping, gravity is often prefered.

21. Local production of pumping units can lead to reduced costs for repair and maintenance. Therefore, local production of pumping equipment, together with appropriate financing arrangements for farmers to purchase it, can be crucial to the development of agriculture-based economies.

22. The manufacture of most agricultural machinery, including irrigation components, requires some specialized facilities; often different technologies of varying complexities are used in the manufacturing process. The principle of multi-purpose plants should therefore be considered as a nucleus. As demand increases and progress is made in the mastering of technologies, new specialized units can take over the manufacture of individual products from multi-purpose units.

23. Multi-purpose facilities can be suggested for the production of fittings, water supply and distribution equipment such as pumps, valves, etc., as well as for light agricultural equipment such as rice hullers, dryers, threshers, power tillers, etc. The different production facilities used for different products can be integrated into one multi-purpose plant divided into different shops.

24. Existing multi-purpose plants for the manufacture of capital goods in many developing countries could also be used for the production of specific irrigation components. This would necessitate the planning and organizing of the existing units for these purposes. 1/ For example, quick-coupling irrigation pipes and pumps with light agricultural machinery can be manufactured in the same production facilities by purchasing the required casting products.

25. In this regard, small- and medium-scale enterprises can offer some advantages in comparison to large companies as follows:

(a) Flexibility to respond to market opportunities;

(b) Possibility of being technically more daring and innovative;

(c) Tendency to rely more on sub-contracting within the country, based on technology unpackaging, which facilitates more integration into the local economy.

26. Small- and medium-scale enterprises in developed and more advanced developing countries could play an important role in areas such as transfer of technology, training and financing.

27. In joint agricultural machinery manufacturing projects, small and medium-sized companies seem to be more flexible in negotiating, and the decisions in each phase can often be taken more rapidly, without as many internal regulations and constraints. This is true for both sides, i.e., technology suppliers as well as technology receivers.

1/ For further details see: "Guidelines for the establishment of the multi-purpose agricultural machinery plant", (ID/WG.462/4).

28. The technologies involved in the manufacture of ordinary pumps are generations old and non-proprietary. A good mechanic equiped with casting, machining and welding capabilities, etc., can make centrifugal pumps of the types commonly used by farmers by copying. This is totally different from the copying of patent-protected products, a practice which should be curbed in the environment of international co-operation. Copying prototypes could even be down-engineered if necessary to suit available capabilities and sold to local manufacturers.

29. Training for the development of the agricultural machinery industry in developing countries is of crucial importance. Training is an investment that necessitates long-term planning; it should start at the very beginning, prior to the implementation of joint projects. This requirement necessitates the training of personnel from developing countries at the manufacturer's or supplier's plant and their full participation in production activities, including product development and adaptation as well as prototype fabrication and testing. Developing countries should develop an integrated programme of training for local producers and users of agricultural machinery. In this connection, there are a large number of medium-scale companies in developed countries, some of them specialized in training, that can play a major role in providing training programmes for developing countries in each area of specialization.

30. Financing is one of the major constraints to the development of the industrial sector in general and the agricultural machinery manufacturing subsector in particular in developing countries. However, if highest priority were given to the local manufacture of agricultural machinery, including irrigation equipment, as a key factor in the intensification of cropping needed to achieve food security and self-sufficiency in food production, the financial constraints could be overcome in most developing countries. Choosing an appropriate policy and strategy for allocating the available resources and exploiting the possibilities offered by international institutions such as the World Bank, the International Fund for Agricultural Development (IFAD), the Asian Development Bank, the African Development Bank, the Arab Bank for Economic Development in Africa (BADEA), etc., and other sources can contribute to solving the problems of financing.

31. Technology ownership and manufacturing in the agricultural machinery sector, particularly for tractors and other heavy complex machines such as combine harverters etc. is highly concentrated in developed countries and in a few more advanced developing countries. Equipment and machinery produced in developed countries by large manufacturers have reached a size and sophistication that is frequently not suited to conditions in developing countries, and therefore cannot meet the real needs of these countries. However, many simpler agricultural machinery products such as hand tools, tanks, simple pumps, sprinklers etc. (see Annexes 1 and 2) are produced by small- and medium-scale enterprises, in developed and developing countries. These enterprises offer an extremely useful source of technology and know-how. Therefore emphasis should be placed on the potential offered by these manufacturers both in developing and developed countries whose experience, expertise and flexibility of action have so far not been fully exploited.

III. POINTS FOR DISCUSSION

32. In considering the importance of agriculture in the industrialization process of developing countries and the need to promote a more integrated development between agriculture and industry, the following questions arise:

(a) What factors must be considered in working to achieve a reasonably balanced development of agriculture and industry?

(b) How can the international community assist developing countries to develop possible models for an integrated planning of agriculture and industry in general and the agricultural machinery industry in particular?

33. In relation to irrigation systems, small-scale irrigation schemes with full local participation are winning the confidence of African Governments looking for solutions to the problems of hunger and desertification. Depending upon the pattern of agricultural development and level of mechanization in a country, and with the aims of increasing self-reliance and minimizing the use of foreign exchange, the following factors should be examined in relation to small-scale irrigation:

(a) Supply and production of machinery and components:

(i) Estimates of the type and amount of agricultural machinery in general and irrigation equipment in particular needed to achieve the socio-economic goals of a country or a region;

(ii) Identification of specific industries necessary for the domestic production of the machinery, equipment and implements needed in order to develop the local agricultural sector;

(b) Guidelines for determining the optimal degree of integration (decisions regarding domestic manufacture of parts and components or buying from external sources) for the manufacture of agricultural machinery including irrigation components in developing countries and the promotion of domestic participation in irrigation projects. 2/

34. In relation to the problem of stimulating demand for agricultural machinery in developing countries in general and in Africa in particular, the following questions should be answered:

(a) Can small markets be pooled at the sub-regional and regional levels?

(b) To what extent is consolidation of production (i.e. standardization of equipment) feasible?

(c) What would be the means, internal and/or external, to achieve these objectives?

2/ For further details, see document: "Technological dependency and choice of pumping technologies for irrigation systems" (ID/WG.462/1).

35. In relation to possibilities for co-operation between small- and medium-scale enterprises of developed, more advanced developing and developing countries the following questions should be considered:

(a) What could be the benefits of and possibilities for regional, interregional and international co-operation involving the exchange of technical and commercial information, training, financing, joint ventures and/or multinational production enterprises?

(b) What are the barriers to co-operation between developing countries in the sector and how could the international community contribute to the promotion of this co-operation (rehabilitation, upgrading, and/or creation of new plants)?

36. Considering the importance of rural development to the majority of developing countries, and in particular the importance of developing rural water supplies, the following questions should be examined:

(a) What is the impact of water on rural development and what are the centralized and decentralized alternatives for rural water supply with possible maximum local participation?

(b) How could rural and other small- and medium-scale manufacturing units be involved in simple irrigation pumping systems and other energy-related capital goods projects initiated by national or multilateral sources?

ANNEX 1

AGRICULTURAL MACHINERY PRODUCED IN DEVELOPING COUNTRIES

The term "agricultural machinery" is defined in three broad-based categories, as follows:

Category	Definition
I. (simple)	Hand tools: hoe, machete, spade, weeder, knife, sickle, axe, pick-axe, shovel etc. Manually operated equipment: pedal thresher, hand sprayer, corn sheller, cassava puller and chopper, hand pump, chaff cutter, storage bins etc. Animal-drawn implements: plough, cultivator, leveller, ridger, seeder and fertilizer drill, pump, sugar-cane crusher, reaper, cart etc.
II. (intermediate)	Tractor-drawn basic implements: plough, cultivator, harrow, leveller, seed drill, reaper, trailer etc. Simple, low-cost low-power equipment: power thresher, pump, chaff cutter, corn sheller, peanut decorticator, rice mill, hammer mill, power tiller, low-power engine etc.
III.(standard)	Power-operated equipment: tractor, pump, harvest and post-harvest equipment (may be manufactured in a few developing countries).

ANNEX 2

CATEGORIES OF IRRIGATION EQUIPMENT AND ACCESSORIES
(FOR DIFFERENT LEVELS OF PRODUCTION AND SIZE OF
APPLICATION, IN SEQUENCE OF TECHNOLOGICAL COMPLEXITY)

Category A products

1. Hand pumps
   (a) reciprocating type
   (b) washer chain type
2. Pedal-operated reciprocating pumps
3. Bellows pumps
4. Animal drawn water wheels
5. Windmills
6. Hydraulic ram
7. Sheet metal products (troughs, buckets, pots, pans, taps, accessories)
8. Hand tools for earth moving and handling
9. Water storage tanks (cisterns) of all types, stationary and mobile
10. Wheelbarrows, crowbars, metallic baskets, etc.

Category B products

1. Windmill-driven pumps

2. Submersible pumps

3. Mechanical water lifts

4. Hydrants

5. Couplings

6. Rotating sprinklers

7. Rainers

8. Fertilizer infusion apparatus for irrigation installations

9. Locks and mechanisms

Category C products

1. Panels of all types

2. Instruments

3. Portable installation for trickle irrigation

4. Centrifugal pumps (engine-operated, electrical motor-operated, PTOs)

5. Pumping stations

6. Stationary electric pumping sets

7. Mobile engine-driven pumping sets

8. Maintenance, repair and spare parts production for earth-moving equipment, graders, scrapers, dredgers, excavators, bulldozers.